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HARNESSE, DICKEY & PIERCE, P.L.C. P.O. BOX 828 BLOOMFIELD HILLS, MI 48303			RIDLEY, BASIA ANNA	
			ART UNIT	PAPER NUMBER
			1764	

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Please find below and/or attached an Office communication concerning this application or proceeding.

<b>Office Action Summary</b>	<b>Application No.</b> 09/780,184	<b>Applicant(s)</b> GITTLEMAN ET AL.	
	<b>Examiner</b> Basia Ridley <i>BR</i>	<b>Art Unit</b> 1764	

**-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --**

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 24 December 2003.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 2-11 and 14-47 is/are pending in the application.  
4a) Of the above claim(s) 19,24 and 31-45 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 2-11, 14-18, 20-23, 25-30, 46 and 47 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 24 December 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
a) ☐ All    b) ☐ Some \*    c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)  | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                                   | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____  |

## **DETAILED ACTION**

### ***Allowable Subject Matter***

1. The indicated allowability of claims 13, 15, 20-28 and 30 is withdrawn in view of the newly discovered reference(s) to Meyer (USP 3,011,589) and Bellows et al. (USP 5,604,047).

Rejections based on the newly cited reference(s) follow.

### ***Election/Restrictions***

2. In view of withdrawal of allowability of generic claim 20, the restriction requirement as to the encompassed species is reinstated. Claim 24 is withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to a nonelected Species B, there being no allowable generic or linking claim. The grounds of restriction were set forth in Paper 6. The applicant elected with traverse Species A in Paper 7. Response to said traversal and reasons for maintaining said restriction are set forth in Paper 8.

### ***Claim Rejections - 35 USC § 112***

3. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

4. Claim(s) 2-11, 14-18, 20-23, 25-30 and 46-74 are rejected under 35 U.S.C. 112, first paragraph, because the specification, while being enabling for a system comprising a water-gas shift reactor wherein a layer of carbon monoxide adsorbent may be placed in front of the water gas shift catalyst or the two materials may be combined into a single layer (page 11, lines 34-36), does not reasonably provide enablement for "a second reactor which is a water gas shift reactor (...) wherein the water gas shift reactor includes a second adsorbent adapted to adsorb carbon

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monoxide”, as recited in claims 20 and 46. The specification does not enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and operate a system commensurate in scope with these claims. The broad claim language encompasses all reactors which comprise both, a shift catalyst and carbon monoxide adsorbent, while the specification only provides enablement for two specific embodiments of said reactors. The specification does not enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and operate a system, wherein, for example the adsorbent zone is located downstream from the water gas shift zone.

***Claim Rejections - 35 USC § 103***

5. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

6. Claims 46, 7 and 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bellows et al. (USP 5,604,047).

Regarding claim(s) 46, Bellows et al. disclose(s) system comprising:

- a first reactor which produces a hydrogen-containing stream gas stream comprising CO (C2/L28-36);
- a second reactor, which is a water-gas shift reactor disposed downstream of said first reactor (C2/L28-36).

While the reference discloses a first adsorbent (21) adapted to adsorb the carbon monoxide (Fig. 1), it does not explicitly disclose said first adsorbent located in the second reactor. As the instant specification is silent to unexpected results, it would have been prima facie obvious for one having ordinary skill in the art to combine the second reactor and the third

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reactor (20) having the first adsorbent into one vessel, with the reasonable expectation of eliminating the need for a separate vessels. One of ordinary skill in the art would have been motivated to forgo use of separate vessels, by combining their function and benefit, where doing so is technically feasible and would reduce cost. See *In re Thompson*, 545 F.2d 1290, 1229, 188 USPQ 365, 367 (CCPA 1976). Therefore, one of ordinary skill in the art would have expected that the combination of water-shift reactor and the adsorbent vessel would avoid costs associated with the installation and operation of two vessels. *In re Thompson*, 545 F.2d 1290, 1294, 192 USPQ 275, 277 (CCPA 1976); *In re Clinton*, 527 F.2d 1226, 1229, 188 USPQ 365, 367 (CCPA 1976). Further, the examiner notes that said modification would merely involve making elements integral, and it has been set that making elements integral is generally recognized as being within the level of ordinary skill in the art. *In re Larson*, 340 F.2d 965, 968, 144 USPQ 347, 349 (CCPA 1965).

Regarding claims 7 and 29 Bellows et al. discloses all of the claim limitations as set forth above. Additionally the reference discloses the system wherein:

- the system is a fuel cell system (C1/L14-45); and wherein
- the preferential oxidizer is eliminated from the system (Fig. 1).

7. Claims 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over Bellows et al. (USP 5,604,047), as applied to claim 46 above, in view of Hufton et al. ("Sorption Enhanced Reaction Process for Hydrogen Production", AICHE).

Regarding claim 14, Bellows et al. discloses all of the claim limitations as set forth above. Additionally the reference discloses that a conventional processes are used to produce said hydrogen-containing stream gas stream (C2/L28-36) but the reference does not explicitly

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disclose said water-gas shift reactor being a high temperature water-gas shift reactor.

Huften et al. teaches a conventional system for preparation of hydrogen-containing stream gas stream wherein said system comprises a first reactor which produces a hydrogen-containing stream gas stream comprising CO, a water-gas shift reactor and an adsorbent vessel (Fig. 1), wherein the water-gas shift reactor is a high temperature water-gas shift reactor (page 248, column 2, lines 1-2).

It would have been obvious to one having ordinary skill in the art at the time of the invention to use a high temperature water-gas shift reactor in the system of Bellows et al., as taught by Huften et al. since doing so would amount to nothing more than a use of a known apparatus for its intended use in a known environment to accomplish entirely expected result.

8. Claims 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over Bellows et al. (USP 5,604,047), as applied to claim 46 above, in view of Smith et al. (USP 3,699,218) or Meyer (USP 3,011,589).

Regarding claim 15, Bellows et al. discloses all of the claim limitations as set forth above and, additionally the reference discloses a preferred temperature range for adsorption (C3/L60-C4/L4). While the reference does not explicitly disclose said adsorbent being adapted to adsorb carbon monoxide at low temperatures and to desorb carbon monoxide at high temperatures, it was known in the art at the time of the invention that low temperature improves adsorption of carbon monoxide, similarly as high pressure, see Smith et al. (C5/L38-C6/L19) or Meyer (C6/L59-64 and C7/L25-28). Recitation of well known properties of adsorbent does not confer patentability to the claims.

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9. Claims 46-47, 2-3, 8 and 14-15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hufton et al. ("Sorption Enhanced Reaction Process for Hydrogen Production", AICHE) in view of Meyer (USP 3,011,589).

Regarding claim(s) 46-47, 8 and 15, Hufton et al. disclose(s) system comprising:

- a first reactor which produces a hydrogen-containing stream gas stream comprising CO (Fig. 1);
- a second reactor, which is a water-gas shift reactor disposed downstream of said first reactor, said water-gas shift reactor (Fig. 1); and
- a vessel downstream of said water-gas shift reactor, said vessel housing a second adsorbent adapted to adsorb the carbon monoxide (Fig. 1).

The reference does not explicitly disclose a first adsorbent adapted to adsorb the carbon monoxide in the second reactor.

Meyer teaches a system for production of hydrogen comprising a second adsorbent (C6/L5-14) adapted to remove carbon monoxide from gas comprising hydrogen and carbon monoxide, the system further comprising a first adsorbent (C4/L68-75) adapted to remove carbon monoxide, upstream said second adsorbent. Wherein at least one of the first and second adsorbent is selected from the group consisting of 5A zeolite, 13X zeolite, and mixtures thereof (C4/L68-75 and C6/L5-14) and wherein the first adsorbent is adapted to adsorb carbon monoxide at low temperatures and is adapted to desorb carbon monoxide at high temperatures (C6/L59-64 and C7/L25-28). Use of initial (first) adsorbent improves economy and efficiency of the system (C4/L33-45).

It would have been obvious to one having ordinary skill in the art at the time of the

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invention to include an initial adsorbent adapted to remove carbon monoxide from gas comprising hydrogen and carbon monoxide in the system of Hufton et al., as taught by Meyer, for the purpose of improving system economy and efficiency.

Further, as the instant specification is silent to unexpected results, it would have been prima facie obvious for one having ordinary skill in the art to combine the water gas shift reactor and the initial adsorber of Hufton et al. in view of Meyer, with the reasonable expectation of eliminating the need for a separate vessels. One of ordinary skill in the art would have been motivated to forgo use of separate vessels, by combining their function and benefit, where doing so is technically feasible and would reduce cost. See *In re Thompson*, 545 F.2d 1290, 1229, 188 USPQ 365, 367 (CCPA 1976). Therefore, one of ordinary skill in the art would have expected that the combination of water-shift reactor and the adsorbent vessel would avoid costs associated with the installation and operation of two vessels. *In re Thompson*, 545 F.2d 1290, 1294, 192 USPQ 275, 277 (CCPA 1976); *In re Clinton*, 527 F.2d 1226, 1229, 188 USPQ 365, 367 (CCPA 1976). Further, the examiner notes that said modification would merely involve making elements integral, and it has been set that making elements integral is generally recognized as being within the level of ordinary skill in the art. *In re Larson*, 340 F.2d 965, 968, 144 USPQ 347, 349 (CCPA 1965).

Regarding claims 2-3 and 14 Hufton et al. in view of Meyer disclose all of the claim limitations as set forth above. Additionally Hufton et al. discloses the system wherein:

- wherein the vessel is a pressure swing adsorber (Fig. 1);
- wherein the pressure swing adsorber comprises multiple staged fixed beds (page 248, column 2, lines 19-20); and



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- wherein the water gas shift reactor is a high temperature water gas shift reactor (page 248, column 2, lines 1-2).

10. Claim(s) 4-7, 16-18 and 29 rejected under 35 U.S.C. 103(a) as being unpatentable over Hufton et al. ("Sorption Enhanced Reaction Process for Hydrogen Production", AICHE) in view of Meyer (USP 3,011,589), as applied to claims 46-47 and 2 above, in view of Keefer et al. (WO 00/16425).

Regarding claim(s) 4, Hufton et al. in view of Meyer disclose all of the claim limitations as set forth above, but the references do not explicitly disclose said pressure swing adsorber comprising a rotating vessel, nor do the references disclose the specifics of said vessel.

Keefer et al. teaches a pressure swing adsorption system for hydrogen purification comprising rotating vessel (P25/L10-20 and P27/L31-P28/L8). The rotating pressure swing adsorption system is more efficient than conventional systems (P3/L1-26). Additionally said rotating pressure swing adsorption system is less complicated and less expensive to install and it requires less inventory of adsorbent (P3/L1-26).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to use the rotating PSA vessel of Keefer et al. in the system of Hufton et al. in view of Meyer, for the purpose of increasing system efficiency and lowering capital and operation costs.

Regarding claim(s) 5-6 and 16-17 Hufton et al. in view of Meyer and further in view of Keefer et al. disclose(s) all of the claim limitations as set forth above. Additionally, Keefer et al. discloses the system wherein:

- the rotating vessel comprises an adsorption region, a depressurization region, a purge region

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and a pressurization region (Fig. 1-6 and P7/L20-P15/L4);

- the rotating vessel comprises two fixed valve faces (P9/L2-9);
- the system further comprising an expander downstream of the vessel, wherein the expander provides a purge gas to be fed back into the vessel (Fig. 1-4); and
- a fuel cell stack having an anode exhaust, the fuel cell stack disposed between the vessel and the expander, and wherein the expander expands the anode exhaust, the expanded anode exhaust providing the purge gas to be fed back into the vessel (P25/L10-27 and P27/L21-P28/L8).

Regarding claim(s) 7 Hufton et al. in view of Meyer disclose all of the claim limitations as set forth above. While Hufton et al. does not disclose any specific use for produced hydrogen gas, it was well known in the art at the time of the invention that fuel-cells need hydrogen for production of electricity, as evidenced by Keefer et al. (P1/L4-P2/L32). Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to use hydrogen produced in the system of Hufton et al. in view of Meyer in a fuel cell system, as doing so would amount to nothing more than use of a known material for its intended use in a known environment to accomplish entirely expected result.

Regarding claim 18, Hufton et al. in view of Meyer and further in view of Keefer et al. disclose all of the claim limitations as set forth above. Additionally, Keefer et al. discloses the system wherein the expander is adapted to provide electrical power for driving the rotating vessel (P11/L6-19, P13/L5-7, P16/L30-P17/L12, P22/L31-P23-9, P25/L10-27 and P27/L21-P28/L8). While the references do not disclose said expander being an isothermal expander, as isothermal expanders are conventional, using an isothermal expander in the system of Hufton et al. in view of Meyer and further in view of Keefer et al. would amount to nothing more than a use of a

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known apparatus for its intended use in a known environment to accomplish entirely expected result.

Regarding claim(s) 29 Hufton et al. in view of Meyer and further in view of Keefer et al. disclose(s) all of the claim limitations as set forth above. Additionally, all references disclose discloses the system wherein the preferential oxidizer is eliminated from the system (Fig. 1 of Hufton et al. and Meyer and Fig. 12-13 of Keefer et al.).

11. Claim(s) 9-11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hufton et al. ("Sorption Enhanced Reaction Process for Hydrogen Production", AICHE), in view of Meyer (USP 3,011,589), as applied to claim 47 above, in view of Kirshnamurthy (USP 5,096,470).

Regarding claim(s) 9, Hufton et al. in view of Meyer disclose(s) all of the claim limitations as set forth above. Additionally Hufton et al. is not limited to any specific adsorbents which can be used in PSA vessel. As adsorbents selected from the group consisting of oxides or salts of copper impregnated or exchanged on activated carbon, alumina and zeolites, oxides or salts of silver impregnated or exchanged on activated carbon, alumina and zeolites, oxides or salts of tin impregnated or exchanged on activated carbon, alumina and zeolites, and mixtures thereof, were known to be useful in the PSA systems for separation of hydrogen from gas streams containing hydrogen and CO, as evidenced by Kirshnamurthy (C7/L14-C8/L2), and further, as the instant specification is silent to unexpected results, it would have been obvious to one having ordinary skill in the art at the time the invention was made to use any adsorbent disclosed by Kirshnamurthy in the PSA system of Hufton et al., as doing so would amount to nothing more than to use of a known material for its intended use in a known environment to accomplish entirely expected result.

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Regarding claim(s) 10-11, Hufton et al. in view of Meyer disclose(s) all of the claim limitations as set forth above, but it does not explicitly disclose a desiccant material selected from the group consisting of zeolite molecular sieves, activated alumina, silica gels, and mixtures thereof disposed upstream of the CO adsorbent.

Kirshnamurthy teaches that is known in the art to pass the feed to the PSA adsorber through a layer of desiccant selected from the group consisting of zeolite molecular sieves, activated alumina, silica gels, and mixtures thereof for the purpose of removing water from said feed..

It would have been obvious to one having ordinary skill in the art at the time the invention was made to use layer of desiccant, as taught by of Kirshnamurthy upstream of the adsorbent of Hufton et al. in view of Meyer, for the purpose of improving system operation by removing water from feed to said adsorbent.

12. Claims 20-23, 25-26 and 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hufton et al. ("Sorption Enhanced Reaction Process for Hydrogen Production", AIChE) in view of Meyer (USP 3,011,589) and further in view of Keefer et al. (WO 00/16425).

Regarding claim(s) 20 and 25-26, Hufton et al. disclose(s) system comprising:

- a first reactor which produces a hydrogen-containing stream gas stream comprising CO (Fig. 1);
- a second reactor, which is a water-gas shift reactor disposed downstream of said first reactor, said water-gas shift reactor (Fig. 1); and
- a vessel downstream of said water-gas shift reactor, said vessel housing a first adsorbent adapted to adsorb the carbon monoxide (Fig. 1);

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- wherein said vessel is a pressure swing adsorber (Fig. 1).

The reference does not explicitly disclose a second adsorbent adapted to adsorb the carbon monoxide in the second reactor. Neither does it disclose the pressure swing adsorber comprising a rotating vessel, nor does the reference disclose the specifics of said vessel.

Meyer teaches a system for production of hydrogen comprising a first adsorbent (C6/L5-14) adapted to remove carbon monoxide from gas comprising hydrogen and carbon monoxide, the system further comprising a second adsorbent (C4/L68-75) adapted to remove carbon monoxide, upstream said first adsorbent. Wherein the first adsorbent is further adapted to adsorb at least one of carbon dioxide and water from the hydrogen gas stream (C4/L68-75 and C6/L5-14). Wherein the first adsorbent is selected from the group consisting of 5A zeolite, 13X zeolite, and mixtures thereof (C4/L68-75 and C6/L5-14) and wherein the second adsorbent is adapted to adsorb carbon monoxide at low temperatures and is adapted to desorb carbon monoxide at high temperatures (C6/L59-64 and C7/L25-28). Use of the initial (second) adsorbent improves economy and efficiency of the system (C4/L33-45).

It would have been obvious to one having ordinary skill in the art at the time of the invention to include an initial adsorbent adapted to remove carbon monoxide from gas comprising hydrogen and carbon monoxide in the system of Hufton et al., as taught by Meyer, for the purpose of improving system economy and efficiency.

Further, as the instant specification is silent to unexpected results, it would have been prima facie obvious for one having ordinary skill in the art to combine the water gas shift reactor and the initial adsorber of Hufton et al. in view of Meyer, with the reasonable expectation of eliminating the need for a separate vessels. One of ordinary skill in the art would have been

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motivated to forgo use of separate vessels, by combining their function and benefit, where doing so is technically feasible and would reduce cost. See *In re Thompson*, 545 F.2d 1290, 1229, 188 USPQ 365, 367 (CCPA 1976). Therefore, one of ordinary skill in the art would have expected that the combination of water-shift reactor and the adsorbent vessel would avoid costs associated with the installation and operation of two vessels. *In re Thompson*, 545 F.2d 1290, 1294, 192 USPQ 275, 277 (CCPA 1976); *In re Clinton*, 527 F.2d 1226, 1229, 188 USPQ 365, 367 (CCPA 1976). Further, the examiner notes that said modification would merely involve making elements integral, and it has been set that making elements integral is generally recognized as being within the level of ordinary skill in the art. *In re Larson*, 340 F.2d 965, 968, 144 USPQ 347, 349 (CCPA 1965).

Keefer et al. teaches a pressure swing adsorption system for hydrogen purification comprising rotating vessel (P25/L10-20 and P27/L31-P28/L8). Wherein the rotating vessel comprises an adsorption region, a depressurization region, a purge region and a pressurization region (Fig. 1-6 and P7/L20-P15/L4); and comprises two fixed valve faces (P9/L2-9). The rotating pressure swing adsorption system is more efficient than conventional systems (P3/L1-26). Additionally said rotating pressure swing adsorption system is less complicated and less expensive to install and it requires less inventory of adsorbent (P3/L1-26).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to use the rotating PSA vessel of Keefer et al. in the system of Hufton et al. in view of Meyer, for the purpose of increasing system efficiency and lowering capital and operation costs.

Regarding claim(s) 21-22 Hufton et al. in view of Meyer and further in view of Keefer et

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al. disclose(s) all of the claim limitations as set forth above. Additionally, Keefer et al. discloses the system wherein:

- the system further comprising an expander downstream of the vessel, wherein the expander provides a purge gas to be fed back into the vessel (Fig. 1-4); and
- a fuel cell stack having an anode exhaust, the fuel cell stack disposed between the vessel and the expander, and wherein the expander expands the anode exhaust, the expanded anode exhaust providing the purge gas to be fed back into the vessel (P25/L10-27 and P27/L21-P28/L8).

Regarding claim 23, Hufton et al. in view of Meyer and further in view of Keefer et al. disclose all of the claim limitations as set forth above. Additionally, Keefer et al. discloses the system wherein the expander is adapted to provide electrical power for driving the rotating vessel (P11/L6-19, P13/L5-7, P16/L30-P17/L12, P22/L31-P23-9, P25/L10-27 and P27/L21-P28/L8). While the references do not disclose said expander being an isothermal expander, as isothermal expanders are conventional, using an isothermal expander in the system of Hufton et al. in view of Meyer and further in view of Keefer et al. would amount to nothing more than a use of a known apparatus for its intended use in a known environment to accomplish entirely expected result.

Regarding claim(s) 30 Hufton et al. in view of Meyer and further in view of Keefer et al. disclose(s) all of the claim limitations as set forth above. Additionally, all references disclose discloses the system wherein the preferential oxidizer is eliminated from the system (Fig. 1 of Hufton et al. and Meyer and Fig. 12-13 of Keefer et al.).

13. Claim(s) 27-28 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hufton et al. ("Sorption Enhanced Reaction Process for Hydrogen Production", AICHE), in view of Meyer

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(USP 3,011,589), in view of Keefer et al. (WO 00/16425) as applied to claim 20 above, in view of Kirshnamurthy (USP 5,096,470).

Regarding claim(s) 27, Hufton et al. in view of Meyer and further in view of Keefer et al. disclose(s) all of the claim limitations as set forth above. Additionally Hufton et al. is not limited to any specific adsorbents which can be used in PSA vessel. As adsorbents selected from the group consisting of oxides or salts of copper impregnated or exchanged on activated carbon, alumina and zeolites, oxides or salts of silver impregnated or exchanged on activated carbon, alumina and zeolites, oxides or salts of tin impregnated or exchanged on activated carbon, alumina and zeolites, and mixtures thereof, were known to be useful in the PSA systems for separation of hydrogen from gas streams containing hydrogen and CO, as evidenced by Kirshnamurthy (C7/L14-C8/L2), and further, as the instant specification is silent to unexpected results, it would have been obvious to one having ordinary skill in the art at the time the invention was made to use any adsorbent disclosed by Kirshnamurthy in the PSA system of Hufton et al., as doing so would amount to nothing more than to use of a known material for its intended use in a known environment to accomplish entirely expected result.

Regarding claim(s) 28, Hufton et al. in view of Meyer and further in view of Keefer et al. disclose(s) all of the claim limitations as set forth above, but it does not explicitly disclose a desiccant material selected from the group consisting of zeolite molecular sieves, activated alumina, silica gels, and mixtures thereof disposed upstream of the CO adsorbent.

Kirshnamurthy teaches that is known in the art to pass the feed to the PSA adsorber through a layer of desiccant selected from the group consisting of zeolite molecular sieves,



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activated alumina, silica gels, and mixtures thereof for the purpose of removing water from said feed..

It would have been obvious to one having ordinary skill in the art at the time the invention was made to use layer of desiccant, as taught by of Kirshnamurthy upstream of the adsorbent of Hufton et al. in view of Meyer and further in view of Keefer et al., for the purpose of improving system operation by removing water from feed to said adsorbent.

14. Claim(s) 46-47, 2-8, 14-17 and 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Keefer et al. (WO 00/16425) in view of Meyer (USP 3,011,589).

Regarding claim(s) 46-47, 8 and 15, Keefer et al. disclose(s) system comprising:

- a first reactor (445 and 544) which produces a hydrogen-rich gas stream comprising CO; and
- a second reactor (448 and 548) which is a water gas shift reactor disposed downstream of said first reactor (445 and 544);
- a vessel (432 and 532) downstream of said water-gas shift reactor (448 and 548), said vessel housing a second adsorbent adapted to adsorb the carbon monoxide.

The reference does not explicitly disclose a first adsorbent adapted to adsorb the carbon monoxide in the second reactor.

Meyer teaches a system for production of hydrogen comprising a second adsorbent (C6/L5-14) adapted to remove carbon monoxide from gas comprising hydrogen and carbon monoxide, the system further comprising a first adsorbent (C4/L68-75) adapted to remove carbon monoxide, upstream said second adsorbent. Wherein at least one of the first and second adsorbent is selected from the group consisting of 5A zeolite, 13X zeolite, and mixtures thereof (C4/L68-75 and C6/L5-14) and wherein the first adsorbent is adapted to adsorb carbon monoxide

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at low temperatures and is adapted to desorb carbon monoxide at high temperatures (C6/L59-64 and C7/L25-28). Use of initial (first) adsorbent improves economy and efficiency of the system (C4/L33-45).

It would have been obvious to one having ordinary skill in the art at the time of the invention to include an initial adsorbent adapted to remove carbon monoxide from gas comprising hydrogen and carbon monoxide in the system of Keefer et al., as taught by Meyer, for the purpose of improving system economy and efficiency.

Further, as the instant specification is silent to unexpected results, it would have been prima facie obvious for one having ordinary skill in the art to combine the water gas shift reactor and the initial adsorber of Keefer et al. in view of Meyer, with the reasonable expectation of eliminating the need for a separate vessels. One of ordinary skill in the art would have been motivated to forgo use of separate vessels, by combining their function and benefit, where doing so is technically feasible and would reduce cost. See *In re Thompson*, 545 F.2d 1290, 1229, 188 USPQ 365, 367 (CCPA 1976). Therefore, one of ordinary skill in the art would have expected that the combination of water-shift reactor and the adsorbent vessel would avoid costs associated with the installation and operation of two vessels. *In re Thompson*, 545 F.2d 1290, 1294, 192 USPQ 275, 277 (CCPA 1976); *In re Clinton*, 527 F.2d 1226, 1229, 188 USPQ 365, 367 (CCPA 1976). Further, the examiner notes that said modification would merely involve making elements integral, and it has been set that making elements integral is generally recognized as being within the level of ordinary skill in the art. *In re Larson*, 340 F.2d 965, 968, 144 USPQ 347, 349 (CCPA 1965).

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Regarding claims 2-7, 14, 16-17 and 29 Keefer et al. in view of Meyer disclose(s) all of the claims limitations as set forth above. Additionally Keefer et al. discloses the system wherein:

- wherein the vessel is a pressure swing adsorber (P25/L10-20 and P27/L31-P28/L8);
- wherein the pressure swing adsorber comprises multiple, staged fixed beds (Fig. 1-6);
- wherein the pressure swing adsorber is a rotating vessel (P25/L10-20 and P27/L31-P28/L8);
- wherein the rotating vessel comprises an adsorption region, a depressurization region, a purge region and a pressurization region (Fig. 1-6 and P7/L20-P15/L4);
- wherein the rotating vessel comprises two fixed valve faces (P9/L2-9);
- wherein the system is a fuel cell system (abstract);
- wherein the water gas shift reactor is a high temperature water gas shift reactor (P25/L28-P26/L31);
- the system further comprising an expander downstream of the vessel, wherein the expander provides a purge gas to be fed back into the vessel (Fig. 1-4); and
- a fuel cell stack having an anode exhaust, the fuel cell stack disposed between the vessel and the expander, and wherein the expander expands the anode exhaust, the expanded anode exhaust providing the purge gas to be fed back into the vessel (P25/L10-27 and P27/L21-P28/L8);
- wherein the preferential oxidizer is eliminated from the system (Fig. 12-13).

15. Claim(s) 9-11 rejected under 35 U.S.C. 103(a) as being unpatentable over Keefer et al. (WO 00/16425) in view of Meyer (USP 3,011,589), as applied to claim 47 above, in view of Kirshnamurthy (USP 5,096,470).

Regarding claim(s) 9, Keefer et al. in view of Meyer disclose all of the claim limitations as set forth above. Additionally Keefer et al. discloses that supported, zeolite type adsorbent can

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be used in the vessel (P8/L14-29 and P17/L22-33). As adsorbents selected from the group consisting of oxides or salts of copper impregnated or exchanged on activated carbon, alumina and zeolites, oxides or salts of silver impregnated or exchanged on activated carbon, alumina and zeolites, oxides or salts of tin impregnated or exchanged on activated carbon, alumina and zeolites, and mixtures thereof, were known to be useful in the PSA systems for separation of hydrogen from gas streams containing hydrogen and CO, as evidenced by Kirshnamurthy (C7/L14-C8/L2), and further, as the instant specification is silent to unexpected results, it would have been obvious to one having ordinary skill in the art at the time the invention was made to use any adsorbent disclosed by Kirshnamurthy in the PSA system of Keefer et al. in view of Meyer, as doing so would amount to nothing more than to use of a known material for its intended use in a known environment to accomplish entirely expected result.

Regarding claim(s) 10-11, Keefer et al. in view of Meyer disclose all of the claim limitations as set forth above and additionally Keefer et al. discloses that water vapor can deactivate the adsorbents (P24/L5-14), but it does not explicitly disclose a desiccant material selected from the group consisting of zeolite molecular sieves, activated alumina, silica gels, and mixtures thereof disposed upstream of the CO adsorbent.

Kirshnamurthy teaches that is known in the art to pass the feed to the PSA adsorber through a layer of desiccant selected from the group consisting of zeolite molecular sieves, activated alumina, silica gels, and mixtures thereof for the purpose of removing water from said feed..

It would have been obvious to one having ordinary skill in the art at the time the invention was made to use layer of desiccant, as taught by of Kirshnamurthy upstream of the

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adsorbent of Keefer et al. in view of Meyer, for the purpose of improving system operation by removing water from feed to said adsorbent.

16. Claim(s) 18 rejected under 35 U.S.C. 103(a) as being unpatentable over Keefer et al. (WO 00/16425) in view of Meyer (USP 3,011,589), as applied to claim 16 above.

Regarding claim 18, Keefer et al. in view of Meyer disclose all of the claim limitations as set forth above. Additionally, the reference discloses the system wherein the expander is adapted to provide electrical power for driving the rotating vessel (P11/L6-19, P13/L5-7, P16/L30-P17/L12, P22/L31-P23-9, P25/L10-27 and P27/L21-P28/L8). While the references do not disclose said expander being an isothermal expander, as isothermal expanders are conventional, using an isothermal expander in the system of Keefer et al. in view of Meyer would amount to nothing more than a use of a known apparatus for its intended use in a known environment to accomplish entirely expected result.

17. Claims 20-23, 25-26 and 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Keefer et al. (WO 00/16425) in view of Meyer (USP 3,011,589).

Regarding claim(s) 20 and 25-26, Keefer et al. disclose(s) system comprising:

- a first reactor (445 and 544) which produces a hydrogen-rich gas stream comprising CO; and
- a second reactor (448 and 548) which is a water gas shift reactor disposed downstream of said first reactor (445 and 544);
- a rotating vessel (432 and 532) downstream of said water-gas shift reactor (448 and 548), said rotating vessel housing a second adsorbent adapted to adsorb the carbon monoxide (P25/L10-20 and P27/L31-P28/L8);
- wherein the rotating vessel is a pressure swing adsorber comprising an adsorption region, a

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depressurization region, a purge region and a pressurization region (Fig. 1-6 and P7/L20-P15/L4); and comparing two fixed valve faces (P9/L2-9).

The reference does not explicitly disclose a second adsorbent adapted to adsorb the carbon monoxide in the second reactor.

Meyer teaches a system for production of hydrogen comprising a first adsorbent (C6/L5-14) adapted to remove carbon monoxide from gas comprising hydrogen and carbon monoxide, the system further comprising a second adsorbent (C4/L68-75) adapted to remove carbon monoxide, upstream said first adsorbent. Wherein the first adsorbent is further adapted to adsorb at least one of carbon dioxide and water from the hydrogen gas stream (C4/L68-75 and C6/L5-14). Wherein the first adsorbent is selected from the group consisting of 5A zeolite, 13X zeolite, and mixtures thereof (C4/L68-75 and C6/L5-14) and wherein the second adsorbent is adapted to adsorb carbon monoxide at low temperatures and is adapted to desorb carbon monoxide at high temperatures (C6/L59-64 and C7/L25-28). Use of the initial (second) adsorbent improves economy and efficiency of the system (C4/L33-45).

It would have been obvious to one having ordinary skill in the art at the time of the invention to include an initial adsorbent adapted to remove carbon monoxide from gas comprising hydrogen and carbon monoxide in the system of Keefer et al., as taught by Meyer, for the purpose of improving system economy and efficiency.

Further, as the instant specification is silent to unexpected results, it would have been prima facie obvious for one having ordinary skill in the art to combine the water gas shift reactor and the initial adsorber of Keefer et al. in view of Meyer, with the reasonable expectation of eliminating the need for a separate vessels. One of ordinary skill in the art would have been

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motivated to forgo use of separate vessels, by combining their function and benefit, where doing so is technically feasible and would reduce cost. See *In re Thompson*, 545 F.2d 1290, 1229, 188 USPQ 365, 367 (CCPA 1976). Therefore, one of ordinary skill in the art would have expected that the combination of water-shift reactor and the adsorbent vessel would avoid costs associated with the installation and operation of two vessels. *In re Thompson*, 545 F.2d 1290, 1294, 192 USPQ 275, 277 (CCPA 1976); *In re Clinton*, 527 F.2d 1226, 1229, 188 USPQ 365, 367 (CCPA 1976). Further, the examiner notes that said modification would merely involve making elements integral, and it has been set that making elements integral is generally recognized as being within the level of ordinary skill in the art. *In re Larson*, 340 F.2d 965, 968, 144 USPQ 347, 349 (CCPA 1965).

Regarding claim(s) 21-22 Keefer et al. in view of Meyer disclose(s) all of the claim limitations as set forth above. Additionally, Keefer et al. discloses the system wherein:

- the system further comprising an expander downstream of the vessel, wherein the expander provides a purge gas to be fed back into the vessel (Fig. 1-4); and
- a fuel cell stack having an anode exhaust, the fuel cell stack disposed between the vessel and the expander, and wherein the expander expands the anode exhaust, the expanded anode exhaust providing the purge gas to be fed back into the vessel (P25/L10-27 and P27/L21-P28/L8).

Regarding claim 23, Keefer et al. in view of Meyer disclose all of the claim limitations as set forth above. Additionally, Keefer et al. discloses the system wherein the expander is adapted to provide electrical power for driving the rotating vessel (P11/L6-19, P13/L5-7, P16/L30-P17/L12, P22/L31-P23-9, P25/L10-27 and P27/L21-P28/L8). While the references do not disclose said expander being an isothermal expander, as isothermal expanders are conventional,

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using an isothermal expander in the system of Hufton et al. in view of Meyer and further in view of Keefer et al. would amount to nothing more than a use of a known apparatus for its intended use in a known environment to accomplish entirely expected result.

Regarding claim(s) 30 Keefer et al. in view of Meyer disclose(s) all of the claim limitations as set forth above. Additionally, all references disclose discloses the system wherein the preferential oxidizer is eliminated from the system (Fig. 1 of Meyer and Fig. 12-13 of Keefer et al.).

18. Claim(s) 27-28 are rejected under 35 U.S.C. 103(a) as being unpatentable over Keefer et al. (WO 00/16425) in view of Meyer (USP 3,011,589), as applied to claim 20 above, in view of Kirshnamurthy (USP 5,096,470).

Regarding claim(s) 27, Keefer et al. in view of Meyer disclose(s) all of the claim limitations as set forth above. Additionally Keefer et al. discloses that supported, zeolite type adsorbent can be used in the vessel (P8/L14-29 and P17/L22-33). As adsorbents selected from the group consisting of oxides or salts of copper impregnated or exchanged on activated carbon, alumina and zeolites, oxides or salts of silver impregnated or exchanged on activated carbon, alumina and zeolites, oxides or salts of tin impregnated or exchanged on activated carbon, alumina and zeolites, and mixtures thereof, were known to be useful in the PSA systems for separation of hydrogen from gas streams containing hydrogen and CO, as evidenced by Kirshnamurthy (C7/L14-C8/L2), and further, as the instant specification is silent to unexpected results, it would have been obvious to one having ordinary skill in the art at the time the invention was made to use any adsorbent disclosed by Kirshnamurthy in the PSA system of



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Keefer et al., as doing so would amount to nothing more than to use of a known material for its intended use in a known environment to accomplish entirely expected result.

Regarding claim(s) 28, Keefer et al. in view of Meyer disclose(s) all of the claim limitations as set forth above, but it does not explicitly disclose a desiccant material selected from the group consisting of zeolite molecular sieves, activated alumina, silica gels, and mixtures thereof disposed upstream of the CO adsorbent.

Kirshnamurthy teaches that is known in the art to pass the feed to the PSA adsorber through a layer of desiccant selected from the group consisting of zeolite molecular sieves, activated alumina, silica gels, and mixtures thereof for the purpose of removing water from said feed..

It would have been obvious to one having ordinary skill in the art at the time the invention was made to use layer of desiccant, as taught by of Kirshnamurthy upstream of the adsorbent of Keefer et al. in view of Meyer, for the purpose of improving system operation by removing water from feed to said adsorbent.

### ***Double Patenting***

19. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. See *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970);and, *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent is shown to be commonly owned with this application. See 37 CFR 1.130(b).

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

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20. Claim(s) 2-11, 14-18, 20-23, 25-30 and 46-47 are rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-34 of U.S. Patent No. 6,692,545 in view of in view of Meyer (USP 3,011,589), as applied to claim 20 above, in view of Kirshnamurthy (USP 5,096,470).

Claims 1-34 of U.S. Patent No. 6,692,545 recite all of the claim limitations as recited in rejected claims, but they do not recite a rotating vessel comprising carbon monoxide adsorbent.

Meyer teaches a system for production of hydrogen comprising a two adsorbent zones (C6/L5-14) adapted to remove carbon monoxide from gas comprising hydrogen and carbon monoxide. Use of two consecutive adsorbents improves economy and efficiency of the system (C4/L33-45).

It would have been obvious to one having ordinary skill in the art at the time of the invention to include a vessel comprising a second adsorbent adapted to remove carbon monoxide from gas comprising hydrogen and carbon monoxide in the system of recited in claims 1-34 of U.S. Patent No. 6,692,545, as taught by Meyer, for the purpose of improving system economy and efficiency.

Keefer et al. teaches adsorbent for removing carbon monoxide from hydrogen comprising gas, said adsorbent comprising rotating vessel (P25/L10-20 and P27/L31-P28/L8). Wherein the rotating vessel comprises an adsorption region, a depressurization region, a purge region and a pressurization region (Fig. 1-6 and P7/L20-P15/L4); and comprises two fixed valve faces (P9/L2-9). The rotating pressure swing adsorption system is more efficient than conventional systems (P3/L1-26). Additionally said rotating pressure swing adsorption system is less complicated and less expensive to install and it requires less inventory of adsorbent (P3/L1-26).

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It would have been obvious to one having ordinary skill in the art at the time the invention was made to use the rotating PSA vessel of Keefer et al. as the second adsorbent vessel in the system of recited in claims 1-34 of U.S. Patent No. 6,692,545, in view of Meyer, for the purpose of increasing system efficiency and lowering capital and operation costs.

***Response to Arguments***

21. Applicant's arguments filed on 24 December 2003 have been considered but are moot in view of the new ground(s) of rejection.

***Conclusion***


22. In view of the foregoing, none of the claims are allowed.


23. Any inquiry concerning this communication or earlier communications from the examiner should be directed to examiner Basia Ridley, whose telephone number is (571) 272-1453. The examiner can normally be reached on Monday through Thursday, from 9:00 AM to 7:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Glenn Caldarola, can be reached on (571) 272-1444.

The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Technical Center 1700 General Information Telephone No. is (571) 272-1700. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Questions on access to the Private PAIR system should be directed to the Electronic Business Center (EBC) at (866) 217-9197 (toll-free).

  
Basia Ridley  
Examiner  
Art Unit 1764

  
JERRY D. JOHNSON  
PRIMARY EXAMINER  
GROUP 1100

BR  
March 21, 2004